

SOURCE RECONSTRUCTION OF THE P300 EVENT-RELATED POTENTIAL AS A BIOMARKER FOR THE EFFICACY OF VAGUS NERVE STIMULATION IN EPILEPSY

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Abstract

The working mechanism of VNS remains to be fully understood, making it impossible to predict a patient's response to the treatment. In the present study, we explore whether EEG source reconstruction of the P300 event-related potential can provide information about the working mechanism and efficacy of VNS.

Keyword(s): biosignals – medical imaging

1. Introduction

Vagus Nerve Stimulation (VNS) is a neurostimulation treatment for refractory epilepsy that reduces seizures with more than 50% in one third of the treated patients. The working mechanism of VNS is currently incompletely understood. This makes it impossible to predict prior to implantation whether a patient will benefit from VNS treatment or not. Therefore, we want to further investigate the working mechanism of VNS and find biomarkers that indicate the efficacy of the treatment.

2. Data and methods

In this study, the P300 component of the event-related potential during the auditory oddball task was investigated in VNS responders (R) and non-responders (NR) under two conditions: VNS turned ON vs. OFF. The P300 component is modulated by the norepinephrine level in the brain, which has been linked to the anti-epileptic effect of VNS [1]. 60-channel EEG was recorded in 10R and 10NR of VNS. The sources of the P300 wave were reconstructed using the multiple volumetric sparse priors algorithm [2]. Individual head models including scalp, skull, cerebrospinal fluid (CSF), gray and white matter, were constructed when a good quality MR image was available (6R + 8NR). For the other patients,

a template head model, including scalp, skull, CSF and brain, was used. All activity was normalized to the template and second level analysis was performed in the statistical parametric mapping software to find significant differences between the R and NR.

3. Results

Significant differences in brain activity for R vs. NR were found in the left hippocampus, fusiform gyrus and insular lobe ($p_{\text{corr}} < 0.001$), indicating a possible biomarker for the efficacy of VNS.

Significant differences in brain activity were found for VNS OFF vs. ON in the left and right hippocampus and amygdala ($p_{\text{uncorr}} < 0.02$), indicating that the limbic system is involved in the mechanism of action of VNS.

If we look at the difference between VNS OFF and ON in each group separately, there is an indication that the right hippocampus is more influenced by VNS in R than in NR, while the opposite holds for the left middle orbital gyrus. However, no significance was reached.

4. Conclusion

Although more research is needed, we showed the potential of EEG source reconstruction in VNS research.

References

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